positive integer) audio signals supplied from at least one signal source into two-channel signals on the basis of two series of impulse responses from a sound source to left and right ears of a listener;

a second conversion process of independently performing reflective sound adding processes [for a pair of] by performing uncorrelated processing [means for] by setting [a] delay [time] times corresponding to predetermined respective transfer functions [with respect to] relating to reflective sound components on the two-channel [output] signals output from the first conversion process, and

a process of respectively reproducing two-channel output signals subjected to the second conversion process near left and right ears of the listener.

REMARKS

Claims 1-8 remain in the application with claims 1-3 and 5-8 having been amended hereby.

Reconsideration is respectfully requested of the rejection of claims 4, 6, and 7 under 35 USC § 112, second paragraph, as being indefinite.

The claims have been amended hereby to meet the objections raised by the examiner. In regard to claim 4,

that claim had been amended in a Preliminary Amendment originally filed with the application and the objected-to phrase was eliminated in that preliminary amendment. Submitted herewith as Exhibit A is a copy of the Preliminary Amendment filed October 29, 1999 with the instant application.

Claims 6 and 7 have been amended hereby to change the dependency so that they depend from claim 5, which recites the detection means.

Accordingly, by reason of the amendments made to the claims hereby, as well as in the Preliminary Amendment it is respectfully submitted that the claims are clear and definite in their recitation of the present invention and meet all requirements of 35 USC § 112.

Reconsideration is respectfully requested of the rejection of claims 1 and 4-8 under 35 USC § 102(e), as being anticipated by Yamada et al.

The present invention relates to an audio processing apparatus for use with headphones that is intended to provide a better and more realistic sound imaging using the conventional stereo input signals, for example. By providing two stages of processing, each of which involves digital filters and predetermined transfer functions. As seen in Fig. 1, the first signal processing unit comprises digital filters that receive the input signals and produce two filter output signals.

The filtering is performed according to predetermined transfer functions based on finite impulse response characteristics determined beforehand. Because there are two stages of filtering provided, the first processing unit need not be as complex as that typically required in audio imaging systems. The second processing occurs in two independent filtering units that are uncorrelated in their respective processing. That is, the predetermined transfer function in one filter is different than the predetermined transfer function in the other filter. The transfer functions being used in these filters are based on reflective sound components. That is, the sound component that might be present in a room with the signal sound source having producing the sound waves reflected back from the walls or ceiling or floor of the room. In contrast, the first signal processing unit uses the finite impulse response characteristics that represent sound that is directly applied from the sound source to the ears of a listener.

The claims have been amended hereby to emphasize the above-noted features of the present invention.

Yamada et al. relates to a headphone processor that is intended to deal with speech signals and, particularly four channel speech signals. In Yamada et al. various embodiments are disclosed for a digital signal processor

utilized in the invention. This digital signal processor is shown in Figs. 2, 6, 8, and 10. The examiner points to the embodiment of Fig. 8 as anticipating the present invention.

Nevertheless, it is respectfully submitted that Yamada et al. does not disclose a first filter mean for converting n channels into two channels. The examiner points to filters 16 and 17 of the digital signal processing circuit of Yamada et al. as producing two signals. Nevertheless, it will be seen that, in fact, it is filters 16, 17, 18, and 19 that are necessary in order to produce the two signals. A left and right filter pair is required for each input signal.

Moreover, it is respectfully submitted that Yamada et al. does not provide a pair of filters that set different delay times. In fact, Yamada et al. requires four filters in order to operate correctly. Moreover, the phase difference addition circuits 30 and 31, both left and right channels, do not provide uncorrelated processing. In fact, the phase difference circuits all operate the same, as shown in Fig. 9, and all receive the same control signal from the head turning detector 8. Therefore, there is no uncorrelated processing going on among the four phase difference addition circuits of Yamada et al.

In addition, the present invention is not intended

to deal with speech signal necessarily and is particularly intended to provide some changes to the audio output of the headphone to indicate a reflective sound component. A pair of second filters in the present invention provides the suitable processing to set different delay times corresponding to respective predetermined transfer functions that relate to these reflective sound components.

It is respectfully submitted that Yamada et al. is completely silent concerning any such reflective sound components and, thus, fails to anticipate the present invention.

Reconsideration is respectfully requested of the rejection of claims 2 and 3 under 35 USC § 103, as being unpatentable over Yamada et al. in view of Ogawa et al.

Claims 2 and 3 depend from claim 1, which as stated above is thought to be patentably distinct over the cited reference and, for at least those very same reasons, claims 2 and 3 are also submitted to be patentably distinct thereover.

Claims 2 and 3 relate to details of the pair of second filters and, according to the examiner, Ogawa et al. is cited to show the use of delay circuits in an audio processor. It is respectfully submitted that Ogawa et al. does not cure the deficiencies of Yamada et al.

concerning the present invention.

Accordingly, by reason of the amendments made to the claims, hereby, as well as the above remarks, it is respectfully submitted that an audio processing apparatus and method as taught by the present invention and as recited in the amended claims is neither shown nor suggested in the cited references, alone or in combination.

The references cited as of interest have been reviewed and are not seen to show or suggest the present invention as recited in the amended claims.

Favorable reconsideration is earnestly solicited.

Respectfully submitted,

COOPER & DUNHAM LLP

Jay H. Maioli
Reg. No. 27, 213

JHM:gr

VERSION WITH MARKINGS TO SHOW CHANGES MADE

MADE IN THE CLAIMS

Please amend claims 1-3 and 5-8 by rewriting same to read as follows.

--1. (Twice Amended) An audio processing apparatus comprising:

first filter means for processing the n-channel audio signals in accordance with predetermined finite impulse response characteristics and for converting n-channel (n ∃ 1, positive integer) audio signals supplied from at least one signal source into two-channel signals;

a pair of second filter means to which the two-channel signals output from the first filter means are respectively supplied for providing an uncorrelated processing by setting different delay times corresponding to respective predetermined transfer functions to the two-channel signals; and

an output unit for respectively supplying signals output from the pair of second filter means to left and right loudspeaker units of a headphone.

--2. (Twice Amended) The audio processing apparatus according to claim 1, wherein the pair of second filter

means each comprise a digital filter providing uncorrelated processing by setting delay times corresponding to the respective predetermined transfer functions relating to reflective sound components using delay units having different delay times.

--3. (Twice Amended) The audio processing apparatus according to claim 1, wherein the pair of second filter means each comprise a digital filter providing uncorrelated processing by setting delay times corresponding to the respective predetermined transfer functions relating to reflective sound components using a delay unit for outputting a plurality of delay times, a multiplier for setting each delay time output to an arbitrary value, and an adder for adding each multiplier output.

--5. (Twice Amended) The audio processing apparatus according to claim 1, further comprising detection means for detecting a rotational movement of the head of a listener wearing the headphone, wherein the uncorrelated processing of the respective predetermined transfer functions in the pair of second filter means is varied depending on an output from the detection means.

--6. (Twice Amended) The audio processing apparatus according to claim 5, wherein the detection means for detecting the rotational of movement of the head of the listener wearing the headphone is a piezoelectric vibration gyro, and the uncorrelated processing corresponding to the respective predetermined transfer functions in the pair of second filter means is varied depending on an output from the piezoelectric vibration gyro.

--7. (Twice Amended) The audio processing apparatus according to claim 5, wherein the detection means for detecting the rotational movement of the head of the listener wearing the headphone is a geomagnetic azimuth sensor, and the uncorrelated processing corresponding to the respective predetermined transfer functions in the pair of second filter means is varied depending on an output from the geomagnetic azimuth sensor.

--8. (Twice Amended) An audio reproducing method comprising:

a first filtering and conversion process of filtering the n-channel audio signals in accordance with predetermined finite impulse response characteristics and of converting n-channel (n ∃ 1, positive integer) audio signals

supplied from at. least one signal source into two-channel signals on the basis of two series of impulse responses from a sound source to left and right ears of a listener;

a second conversion process of independently performing reflective sound adding processes by performing uncorrelated processing by setting delay times corresponding to predetermined respective transfer functions relating to reflective sound components on the two-channel signals output from the first conversion process, and

a process of respectively reproducing two-channel output signals subjected to the second conversion process near left and right ears of the listener.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Yuji Yamada

Serial No.:

Filed :

For : AUDIO PROCESSING APPARATUS AND AUDIO REPRODUCING METHOD

COPY

October 29, 1999
1185 Avenue of the Americas
New York, NY 10036
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PRELIMINARY AMENDMENT

Hon. Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

Prior to the initial examination of the above-identified application, Applicant respectfully requests that the application be amended as follows.

IN THE SPECIFICATION

Page 20, line 19, after "in" insert -the--.

Page 28, line 1, change "blow" to --below--.

IN THE ABSTRACT OF THE DISCLOSURE

line 1, change "is disclosed which" to --that--;

line 2, delete "means";

line 4, change "filter means" to --filters--;

line 5, change "means";

line 6, delete "with an";

line 7, change "uncorrelation" to --that are not correlated--;

line 8, change "filter means" to --filters--.

IN THE CLAIMS

Please amend claims 1-8 by rewriting same to read as follows.

--1. (Amended) An audio processing apparatus comprising:

[a] first filter means for converting n-channel ($n \geq 1$, positive integer) audio signals supplied from at least one signal source into two-channel signals;

a pair of second filter means to which the two-channel output signals from the first filter means are supplied [and which provides] for providing an uncorrelated processing [means] for setting different delay times for respective transfer functions [to] of the [supplied] two-channel input signals; and

an output unit for supplying [output] signals output from the pair of second filter means to left and right loudspeaker units of a headphone.

--2. (Amended) [An] The audio processing apparatus according to claim 1, wherein the pair of second filter means [are constituted by] each comprise a digital filter[, and a pair of] providing uncorrelated processing [means for] by setting delay times for respective

transfer functions [are constituted by] using delay units having different delay times.

--3. (Amended) [An] The audio processing apparatus according to claim 1, wherein the pair of second filter means [are constituted by] each comprise a digital filter[, and a pair of] providing uncorrelated processing [means for] by setting delay times for respective transfer functions [are constituted by] using a delay unit for outputting a plurality of delay times, a multiplier for setting each delay time output to an arbitrary value, and an adder for adding each multiplier output.

--4. (Amended) [An] The audio processing apparatus according to claim 1, wherein the [pair of] first filter means [are constituted by] comprises a pair of digital filters having [characteristics] the same or equivalent [in] transfer characteristics.

--5. (Amended) [An] The audio processing apparatus according to claim 1, further comprising [a] detection means for detecting a direction of movement of the head of a listener wearing the headphone, wherein the transfer functions of the pair of second filter means are made variable depending on an
output from the detection means.

--6. (Amended) [An] The audio processing apparatus according to claim 1, wherein the detection means for detecting [a] the direction of movement of the head of [a] the listener wearing the headphone is a piezoelectric vibration gyro, and the transfer functions of the pair of second filter means are made variable depending on an output from the piezoelectric vibration gyro.

--7. (Amended) [An] The audio processing apparatus according to claim 1, wherein the detection means for detecting [a] the direction of movement of the head of [a] the listener wearing the headphone is a geomagnetic azimuth sensor, and the transfer functions of the pair of second filter means are made variable depending on an output from the geomagnetic azimuth sensor.

--8. (Amended) An audio reproducing method comprising:

a first conversion process of converting n-channel ($n \geq 1$, positive integer) audio signals supplied from at least one signal source into two-channel signals on the basis of two series of impulse responses from a sound source to left and right ears of a listener;

a second conversion process of independently performing reflective sound adding processes for a pair of uncorrelated processing means for setting a delay time to transfer functions with respect

to two-channel output signals from the first conversion [processing means] process, and

a process of reproducing two-channel output signals subjected to the second conversion process near left and right ears of the listener.--

REMARKS

Claims 1-8 remain in the application and have been amended hereby.

As will be noted from the Declaration, Applicants are citizens and residents of Japan and this application originated there.

Accordingly, the amendments made to the specification are provided to place the application in idiomatic English, and the claims are amended to place them in better condition for examination.

An early and favorable examination on the merits is earnestly solicited.

Respectfully submitted,

COOPER & DUNHAM LLP

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JHM:dmcd